

U.S. Patent Application No. 09/945,340  
Amendment dated March 28, 2005  
Reply to Office Action of December 29, 2004

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**LISTING OF CLAIMS:**

1 - 4. (canceled)

5. (currently amended) A separation device comprising a mobile phase and a stationary phase, wherein said stationary phase comprises carbonaceous material having attached at least one organic group,

wherein the organic group is a phenyl or naphthyl group having ionic or ionizable groups,

or

wherein the organic group comprises an amino acid or derivatized amino acid, cyclodextrin, immobilized protein, polypeptides, or combinations thereof, or

wherein the organic group comprises a -C<sub>6</sub>F<sub>5</sub> group, a trifluoromethyl-phenyl group, a bis-trifluorophenyl group, or combinations thereof, or

wherein the organic group comprises -Ar-(C<sub>n</sub>H<sub>2n+1</sub>)<sub>x</sub> group, wherein n is an integer of from about 1 to about 30 and x is an integer of from about 1 to about 3, or

wherein the organic group comprises an immobilized protein for the separations of racemic mixtures into their optically pure components, or

wherein the organic group comprises polyethylene glycol or methoxy-terminated polyethylene glycol or derivatized resins thereof, or

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wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{COOX})_m$ , wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3, and X is H, a cation, or an organic group, or

wherein the organic group comprises  $\text{Ar}-((\text{C}_n\text{H}_{2n})\text{OH})_m$ , wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{NH}_2)_m$ , wherein n is 0 to 20, m is 1 to 3, or its protonated form:  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{NH}_3\text{X})_m$ , wherein X is an ion, and Ar is an aromatic group, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{CHNH}_3^+\text{COO}^-)_m$  and the reaction products thereof with molecules containing functional groups terminated in  $-\text{NH}_2$ ,  $-\text{OH}$ , or  $-\text{COOH}$ , wherein Ar is an aromatic group and n is 0 to 20, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{CH}=\text{CH}_2)_m$ , wherein n is 0 to 20, m is 1 to 3 or  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{SO}_2\text{CH}=\text{CH}_2)_m$ , where n is 0 to 20 and m is 1 to 3, or

wherein the organic group comprises at least one chiral ligand group, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{CN})_m$ , wherein Ar is an aromatic group, n is 0 to 20, and m is 1 to 3, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{C}(\text{O})\text{N}(\text{H})-\text{C}_x\text{H}_{2x+1})_m$ , wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is 1 to 3, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{N}(\text{H})\text{C}(\text{O})-\text{C}_x\text{H}_{2x+1})_m$ , wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is 1 to 3, or

wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{O}-\text{C}(\text{O})-\text{N}(\text{H})-\text{C}_x\text{H}_{2x+1})_m$ , wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is 1 to 3, or

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wherein the organic group comprises - Ar-((C<sub>n</sub>H<sub>2n</sub>)C(O)N(H)-R)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is 1 to 3, and R is an organic group, or

wherein the organic group comprises - Ar-((C<sub>n</sub>H<sub>2n</sub>)N(H)C(O)-R)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is 1 to 3, and R is an organic group, or

wherein the organic group comprises - Ar-((C<sub>n</sub>H<sub>2n</sub>)O-C(O)N(H)-R)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is 1 to 3, and R is an organic group, or

wherein the organic group comprises an optically active aminoacid or derivatized aminoacid for the separations of racemic mixtures into their optically pure components, or

wherein the organic group comprises cyclodextrin attached through a group -Ar(CH<sub>2</sub>)<sub>n</sub>, where n=0 to 15 for the separations of racemic mixtures into their optically pure components.

6 - 10. (canceled)

11. (withdrawn) ~~The method of claim 6;~~ A method for conducting separation of chemical species from a substance, wherein said method comprises passing said substance through a system containing a mobile phase and a stationary phase, wherein said stationary phase comprises carbonaceous material having attached at least one organic group wherein said separation is electrophoresis or electrochromatography.

12. (withdrawn) A method for conducting separation by electrophoresis comprising a stationary phase and a mobile phase located between a positive electrode and a negative electrode, passing a current between said electrodes, and introducing a substance containing different chemical species to be separated, wherein said stationary phase comprises carbonaceous material having attached at least one organic group.

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13. (withdrawn) A membrane separation system comprising a membrane wherein said membrane comprises carbonaceous material having attached at least one organic group.

14. (withdrawn) The membrane separation system of claim 13, wherein said system is a reverse osmosis system.

15. (withdrawn) An electrophoresis separation comprising a stationary phase, a mobile phase, and a positive electrode and a negative electrode, wherein said stationary phase comprises carbonaceous material having attached at least one organic group.

16. (original) The separation device of claim 5, wherein the organic group is a phenyl or naphthyl group having ionic or ionizable groups.

17. (original) The separation device of claim 5, wherein the organic group comprises an amino acid or derivatized amino acid, cyclodextrin, immobilized protein, polypeptides, or combinations thereof.

18. (original) The separation device of claim 5, wherein the organic group comprises a  $-C_6F_5$  group, a trifluoromethyl-phenyl group, a bis-trifluorophenyl group, or combinations thereof.

19. (original) The separation device of claim 5, wherein the organic group comprises  $-Ar-(C_nH_{2n+1})_x$  group, wherein n is an integer of from about 1 to about 30 and x is an integer of from about 1 to about 3.

20. (original) The separation device of claim 5, wherein the organic group comprises an immobilized protein for the separations of racemic mixtures into their optically pure components.

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21. (original) The separation device of claim 5, wherein the organic group comprises polyethylene glycol or methoxy-terminated polyethylene glycol or derivatized resins thereof.

22. (original) The separation device of claim 5, wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{COOX})_m$ , wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3, and X is H, a cation, or an organic group.

23. (original) The separation device of claim 5, wherein the organic group comprises  $\text{Ar}-((\text{C}_n\text{H}_{2n})\text{OH})_m$ , wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3.

24. (original) The separation device of claim 5, wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{NH}_2)_m$ , wherein n is 0 to 20, m is 1 to 3, or its protonated form:  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{NH}_3\text{X})_m$ , wherein X is an ion, and Ar is an aromatic group.

25. (original) The separation device of claim 5, wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{CHNH}_3^+\text{COO})_m$  and the reaction products thereof with molecules containing functional groups terminated in  $-\text{NH}_2$ ,  $-\text{OH}$ , or  $-\text{COOH}$ , wherein Ar is an aromatic group and n is 0 to 20.

26. (original) The separation device of claim 5, wherein the organic group comprises  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{CH}=\text{CH}_2)_m$ , wherein n is 0 to 20, m is 1 to 3 or  $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{SO}_2\text{CH}=\text{CH}_2)_m$ , where n is 0 to 20 and m is 1 to 3.

27. (original) The separation device of claim 5, wherein the organic group comprises at least one chiral ligand group.

28. (original) The separation device of claim 16, further comprising a second organic group attached on the carbonaceous material.

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29. (original) The separation device of claim 17, further comprising a second organic group attached on the carbonaceous material.

30. (original) The separation device of claim 18, further comprising a second organic group attached on the carbonaceous material.

31. (original) The separation device of claim 19, further comprising a second organic group attached on the carbonaceous material.

32. (original) The separation device of claim 20, further comprising a second organic group attached on the carbonaceous material.

33. (original) The separation device of claim 21, further comprising a second organic group attached on the carbonaceous material.

34. (original) The separation device of claim 22, further comprising a second organic group attached on the carbonaceous material.

35. (original) The separation device of claim 23, further comprising a second organic group attached on the carbonaceous material.

36. (original) The separation device of claim 24, further comprising a second organic group attached on the carbonaceous material.

37. (original) The separation device of claim 25, further comprising a second organic group attached on the carbonaceous material.

38. (original) The separation device of claim 26, further comprising a second organic group attached on the carbonaceous material.

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39. (original) The separation device of claim 28, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

40. (original) The separation device of claim 29, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

41. (original) The separation device of claim 30, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

42. (original) The separation device of claim 31, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

43. (original) The separation device of claim 32, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

44. (original) The separation device of claim 33, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

45. (original) The separation device of claim 34, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

46. (original) The separation device of claim 35, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

47. (original) The separation device of claim 36, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

48. (original) The separation device of claim 37, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

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49. (original) The separation device of claim 38, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

50. (original) The separation device of claim 19, wherein  $n=18$  and  $x=1$ .

51. (original) The separation device of claim 19, wherein  $n=8$  and  $x=1$ .

52. (original) The separation device of claim 50, further comprising a second organic group attached on the carbonaceous material.

53. (original) The separation device of claim 51, further comprising a second organic group attached on the carbonaceous material.

54. (original) The separation device of claim 52, where the second organic group is -  
 $\text{Ar-C}(\text{CH}_3)_3$ .

55. (original) The separation device of claim 53, where the second organic group is -  
 $\text{Ar-C}(\text{CH}_3)_3$ .

56. (original) The separation device of claim 5, wherein the organic group comprises  
 $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{CN})_m$ , wherein Ar is an aromatic group,  $n$  is 0 to 20, and  $m$  is 1 to 3.

57. (original) The separation device of claim 5, wherein the organic group comprises  
 $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{C}(\text{O})\text{N}(\text{H})-\text{C}_x\text{H}_{2x+1})_m$ , wherein Ar is an aromatic group,  $n$  is 0 to 20,  $x$  is 0 to 20 and  $m$  is 1 to 3.

58. (original) The separation device of claim 5, wherein the organic group comprises  
 $-\text{Ar}-((\text{C}_n\text{H}_{2n})\text{N}(\text{H})\text{C}(\text{O})-\text{C}_x\text{H}_{2x+1})_m$ , wherein Ar is an aromatic group,  $n$  is 0 to 20,  $x$  is 0 to 20 and  $m$  is 1 to 3.



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59. (original) The separation device of claim 5, wherein the organic group comprises  
- Ar-((C<sub>n</sub>H<sub>2n</sub>)O-C(O)-N(H)-C<sub>x</sub>H<sub>2x+1</sub>)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20  
and m is 1 to 3.

60. (original) The separation device of claim 5, wherein the organic group comprises  
- Ar-((C<sub>n</sub>H<sub>2n</sub>)C(O)N(H)-R)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is  
1 to 3, and R is an organic group.

61. (original) The separation device of claim 5, wherein the organic group comprises  
- Ar-((C<sub>n</sub>H<sub>2n</sub>)N(H)C(O)-R)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m is  
1 to 3, and R is an organic group.

62. (original) The separation device of claim 5, wherein the organic group comprises  
- Ar-((C<sub>n</sub>H<sub>2n</sub>)O-C(O)N(H)-R)<sub>m</sub>, wherein Ar is an aromatic group, n is 0 to 20, x is 0 to 20 and m  
is 1 to 3, and R is an organic group.

63. (original) The separation device of claim 56, further comprising a second organic  
group attached on the carbonaceous material.

64. (original) The separation device of claim 57, further comprising a second organic  
group attached on the carbonaceous material.

65. (original) The separation device of claim 58, further comprising a second organic  
group attached on the carbonaceous material.

66. (original) The separation device of claim 59, further comprising a second organic  
group attached on the carbonaceous material.

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67. (original) The separation device of claim 60, further comprising a second organic group attached on the carbonaceous material.

68. (original) The separation device of claim 61, further comprising a second organic group attached on the carbonaceous material.

69. (original) The separation device of claim 62, further comprising a second organic group attached on the carbonaceous material.

70. (original) The separation device of claim 63, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

71. (original) The separation device of claim 64, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group

72. (original) The separation device of claim 65, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group

73. (original) The separation device of claim 66, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group

74. (original) The separation device of claim 67, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group

75. (original) The separation device of claim 68, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group

76. (original) The separation device of claim 69, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group

77. (canceled)

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78. (original) The separation device of claim 5, wherein the organic group comprises an optically active aminoacid or derivatized aminoacid for the separations of racemic mixtures into their optically pure components.

79. (original) The separation device of claim 5, wherein the organic group comprises cyclodextrin attached through a group  $-\text{Ar}(\text{CH}_2)_n$ , where  $n=0$  to 15 for the separations of racemic mixtures into their optically pure components.